

Delmarva Fox Squirrel
In-house Report
Prime Hook National Wildlife Refuge/Legates Property
Summer 2008

Prepared by the Delaware Natural Heritage and Endangered Species Program
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Methods

Study Area

Prime Hook National Wildlife Refuge was established in 1963 under the Migratory Bird Conservation Act for use as an inviolate sanctuary expressly for migratory birds. It is located on the west shore of Delaware Bay, approximately 22 miles SE of Dover. The refuge is considered to have one of the best existing wetland habitat areas along the Atlantic Coast. Strategically located on the Atlantic Flyway, the refuge manages 4,200 acres of freshwater marshes which provide feeding and resting areas for migrating birds – especially shorebirds and waterfowl. Grasslands are managed through a combination of mowing, farming, and letting fields grow fallow. These grasslands provide habitat to a variety of native and migratory species including kestrels, red-tailed hawks, turkey vultures, quail and turkeys. The refuge also contains almost 2,300 acres of tidal salt marshes, which provides important nesting grounds for young fish and crabs.

Delmarva fox squirrels (*Sciurus niger cinereus*, DFS) were reintroduced at Prime Hook National Wildlife Refuge (PHNWR) in 1986. Twelve squirrels (6 females, 6 males) were released at Prime Hook National Wildlife Refuge between May 1986 and September 1986. An additional six animals were obtained for a third release at Prime Hook in May of 1987.

The refuge contains more than 1500 acres of forested habitat, approximately 280 acres of which is southern red oak heath forest, whose dominant species are loblolly pine (*Pinus taeda*), oaks (*Quercus* spps.), hickories (*Carya* spps.) and sweet gum (*Liquidambar styraciflua*, McAvoy et al. 2007). Sassafras (*Sassafras albidum*) and American holly (*Ilex opaca*) were common in the understory. The squirrels may also have been using Mesic coastal plain mixed hardwood, mesic coastal plain oak and mesic rich forests, which comprise additional 387 acres of the refuge (see McAvoy et al. 2007 for descriptions). All photomonitoring effort in 2008 was confined to the primary habitat type; southern red oak heath forest.

The Legates property is a private property located on the western side of Route 1, across from the Rookery Golf Course and Prime Hook National Wildlife Refuge. This property was selected because it represents a potential migration site for Prime Hook's DFS population. This property contains 39 acres of forested habitat similar to that found in Prime Hook, with loblolly pines being the predominant tree species. However, due to previous select cut timber harvests, much of the forest had been cleared. The resulting understory was overgrown with briars and many other high-density plants.

Photomonitoring Protocol and Cameras Used

All cameras were set up with trap at base of large tree, baited with corn cobs and loose corn. Cameras were set according to USFWS protocol; trap at base of large tree with bait secured inside and sticks used to secure trap and make bait more difficult to remove.

Timing of rebaiting and end and start times followed USFWS protocol (bait replenished on 4th and 7th day, minimum of 10 days deployed). During each rebaiting, the biologist made sure the cameras were operating by making sure their picture was taken at each camera. If cards were full or if there were doubts regarding cameras' working status, the cards were switched and checked.

Cameras were placed 10-15' from bait and were set to:

- take pictures day and night.
- take 2 pictures in quick succession, then have a 1 minute "quiet period" where no pictures were taken.
- with trigger speed set to fast.
- Reconyx cameras were initially set to high sensitivity but so many pictures were taken that had no animals in the frame, that they were reset to medium sensitivity on 4 Oct., 2007.
- Used one Gigabyte cards for most cameras except Penns Woods brand, which had 64 KB cards.
- A mix of alkaline and rechargeable batteries (new Tenenergy 1.2 V 10000 mAh Nichol-Metal Hydride) were used.

Camera Tests and Performance

Three models of cameras were used; Penns Woods Digital Scout, Leaf River DC 6SS and Reconyx RC55. The Penns Woods cameras were purchased in 2004; prior to the development of the USFWS photomonitoring protocol. They have proven to be effective and were able to detect fox squirrels at Prime Hook National Wildlife Area where trapping could not. The Leaf River DC 6SS cameras were tested and approved by USFWS. The DE NHESP tested side by side with the Penns Woods and a new model (not tested by USFWS or NHESP), the Reconyx RC55.

During a brief side-by-side camera test the Reconyx RC55 consistently recorded gray squirrels when the other two cameras did not. Although all the cameras had their advantages and disadvantages, the Reconyx appeared to be the most effective camera for detecting presence of squirrels, with the Penns Woods coming in a distant second. USFWS found the Leaf Rivers to be effective in areas where squirrels were plentiful but hadn't tested them in areas of low populations, where more sensitive cameras may be less likely to miss individual squirrels. One possible drawback of the Reconyx is that it takes infrared, black and white pictures when light levels are low enough to cause a flash to operate on other digital cameras. Black and white pictures may limit the ability of the surveyor to distinguish squirrel species. We did not find this to be the case, however. All our Reconyx gray squirrel pictures were clear enough to identify

species. The other disadvantage of this camera was that it was so sensitive that it took a lot more pictures than the other cameras. At no time did it fill a 1 GB memory card but it was time consuming to review large numbers of pictures.

The main disadvantage of the Penns Woods cameras was that their battery configuration was difficult to maintain and the wiring was more likely to fail. The batteries had to be changed frequently. The Leaf River camera had a slow trigger speed and missed many animals that the other cameras recorded. However, if the squirrels stayed at the bait, the Leaf River was able to take their pictures. Set up and checking pictures was cumbersome with the Leaf River.

Summer 2008 Effort

Two arrays (I and J; Figures 1 and 2) were deployed within the Prime Hook National Wildlife Refuge and one array (K) deployed to the Legates property (Fig. 3). The arrays consisted of 6-15 cameras and followed USFWS photomonitoring protocol, changed slightly to allow an extended period of camera deployment. Table 1 lists the details for each array. All cameras were baited with a combination of loose and cob corn.

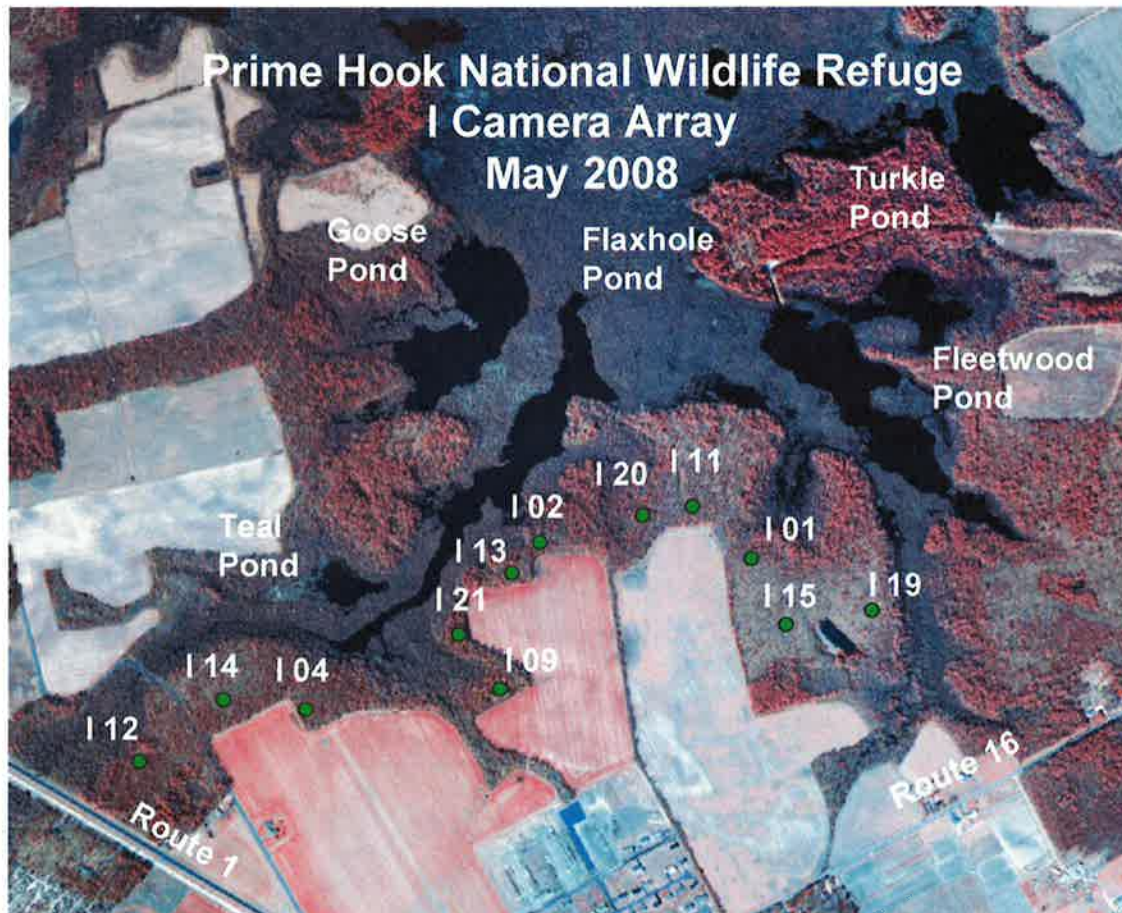


Figure 1. Photomonitoring *Array I* at Prime Hook National Wildlife Refuge, Sussex County, DE. May 2008.

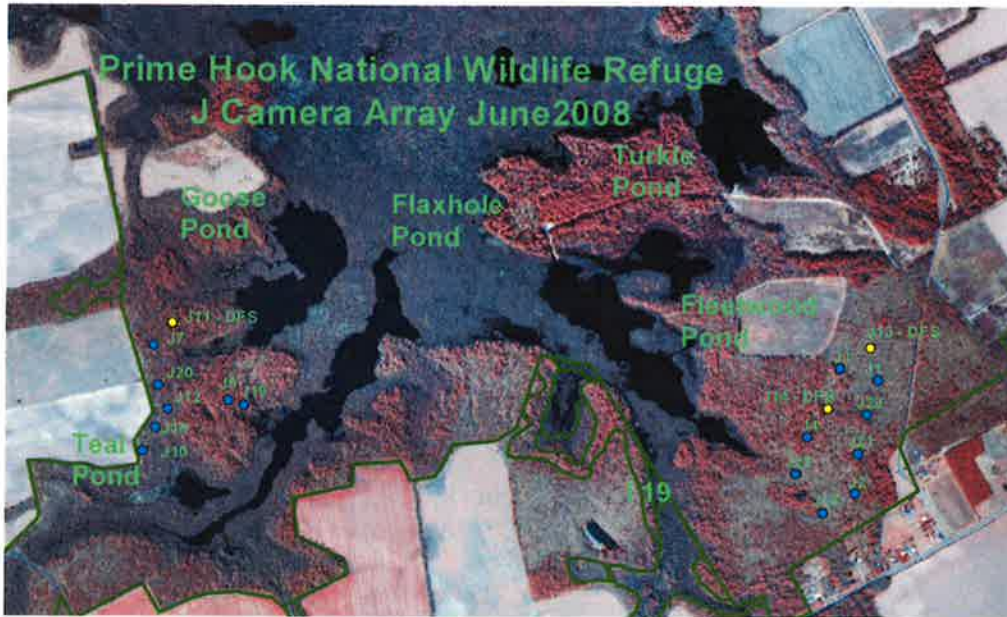


Figure 2. Photomonitoring *Array J* at Prime Hook National Wildlife Refuge, Sussex County, DE. June 2008.



Figure 3. Photomonitoring *Array K* at Legates property, west of Prime Hook National Wildlife Refuge, Sussex County, DE. June 2008.

The first array (I) consisted of 12 cameras – 3 Penns Woods, 6 Leaf River and 3 Reconyx. All were placed in one area of the refuge (Fig. 1). Cameras were re-baited and checked for operating condition on 19, 22 and 28 May. The only camera problem encountered in this array was camera

I-12 – a Leaf River – which saved pictures to the internal memory instead of the card; resulting in only a small number of pictures taken. It was determined that this was due to a bad memory card, which was subsequently replaced (and removed from memory card rotation) restoring proper camera function.

The second array (J) consisted of 15 cameras – 6 Penns Woods, 4 Leaf River and 5 Reconyx – that were deployed to two separate locations with 7 cameras in one location and 8 cameras in the other (Fig. 1). Cameras were rebaited and checked for operating condition on 2, 5 and 9 June. Camera J-13 was accidentally turned off until 2 June. Camera J-7 (a Penns Woods with a picture capacity of 120) had a full memory card on 9 June. J-11 did not have the time set correctly.

The final array (K) included 6 Reconyx cameras that were deployed to the Legates property (Fig. 3). Cameras were rebaited and operating condition checked on 16, 18, 23 and 27 June. During the first check, 23 June, it was found that camera K31 had not taken any pictures. Both the batteries and memory card were changed, but the camera was still not functioning on the 27 June bait check. For this reason the camera was pulled from the field.

In order to determine the relative effort of this photomonitoring project compared with others, we calculated the number of camera days (number of cameras X number of days employed). A “camera day” was only counted if the camera had been fully functional for a full, 24 hour period. Number of acres indicates the number of acres of potential habitat present within the woodlot sampled. Number of cameras days/acre provides a catch per unit effort type analysis that can be used to compare effort.

Table 1 – Summary of spring, 2008 photomonitoring effort at Prime Hook National Wildlife Refuge and Legates Property. Sussex County, DE.

Array ID	Start Date	End Date	No. Camera Days	No. Camera Stations	Acres of Woodlot	Camera Days/Acre
I	May 13	May 27	180	12	78.884	2.28
J	May 29	June 9	175	15	75.092	2.33
K	June 11	July 9	162	6	20.192	8.02
Total 2008 Effort			517	33	174.168	2.97

Camera Days = Number of cameras X number of days deployed and operating properly.

Results

Three camera arrays (2 in Prime Hook and 1 at the Legates property) covered approximately 174 acres of potential habitat (154 acres at Prime Hook, 20 acres at Legates) with a total of 517 camera days (355 at Prime Hook, 162 at Legates). This photomonitoring effort resulted in 15 DFS pictures. Delmarva fox squirrels were verified at I-15, J-11, J-13 and J-14 (Fig. 4) but were not recorded in K array (Legates Property). Both gray squirrels and fox squirrels were documented at J-11 and J-13.

Other species recorded included eastern gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), white-tail deer (*Odocoileus virginianus*), domestic dog (*Canis lupus familiaris*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), northern cardinal (*Cardinalis cardinalis*), wild turkey (*Meleagris gallopavo*), opossum (*Didelphis virginiana*), Eastern cottontail (*Sylvilagus floridanus*) and common grackles (*Quiscalus major*). Potential DFS predators recorded include the red fox and domestic dog, while the other species – especially raccoon, deer, crow and gray squirrel – represented potential food competitors. Great horned owls (*Bubo virginianus*), red-tailed hawks (*Buteo jamaicensis*) and black rat snakes (*Elaphe obsoleta*), also potential DFS predators, were observed on site but not captured on camera.



Figure 4 – Picture of DFS at Prime Hook National Wildlife refuge May/June 2008.

Discussion and Recommendations

The DFS population in the Prime Hook National Wildlife Refuge is clearly still active. Not only were DFS recorded in areas of known DFS activity (J-11, J-13 and J-14), but they were also discovered in one woodlot where DFS activity had not been previously recorded (I-15). Among the areas of previously known DFS activity, camera site J-11 was located within the woodlot that the DFS were released, indicating that this woodlot might still be in use.

Table 2 – Summary of DFS Pictures at Prime Hook National Wildlife Refuge. Sussex County, DE.

Camera	Type	Date	Time	No. DFS Pictures	Days to First DFS Picture	Gray squirrels present?
I-15	Leaf River	May 22, 2008	15:10	2	9	No
J-11	Leaf River	Unknown	Unknown	8	Unknown	Yes (10)
J-13	Leaf River	June 8, 2008	11:19	1	10	Yes (5)
J-14	Leaf River	June 3, 2008	08:00 – 08:10	3	5	No
J-14	Leaf River	June 8, 2008	13:00	1	5	No
Total				15		

At the new site of DFS activity (I-15), only one definite DFS picture was taken (Table 2). A second squirrel picture was taken at this site, but species could not be determined. The I-array camera stations were set with approximately one camera every 5 acres. Camera station J-13 recorded one DFS as well as 5 gray squirrels. It should also be noted that no pictures were taken at J-13 for the first 2 days. Camera station J-14 recorded 4 DFS, three on 3 June and one on 8 June, all of which appeared to be a single, melanistic squirrel.

Unfortunately no DFS were recorded at the Legates property. This would have represented a significant sighting, since it would have provided evidence that the DFS were able to successfully migrate across Highway 1, a busy thoroughfare connecting Eastern PA and NJ to the Delmarva beaches. It should be noted, however, that the Legates habitat was not ideal DFS habitat. Although there were several large pines, the ground cover was dense throughout most of the woodlot. The total acreage of the Legates woodlot was approximately 39 acres; only 20 acres of which was suitable DFS habitat. Of the 20 acres, only a small portion could be described as potentially good DFS habitat. See Fig. 5 for pictures of Legates Property.



Figure 5. Photographs of Legates Property. Sussex County, DE

Parts of the USFWS protocol may warrant updating. Specifically, length of time cameras are deployed and density of cameras in a woodlot. During this study, the first DFS picture was taken 9 days after the set up date for I-15, 10 days for J-13 and 5 for J-14. Although J-array camera stations were only set 300-350' apart (USFWS protocol requires cameras be every 5 acres or approximately 500' apart), the DFS identified in the J-array and I-array were not recorded by neighboring camera stations; possibly indicating that the other cameras were not within their usual home range for that time of year. It could also indicate that they no longer needed food after visiting one camera station. The USFWS protocol for determining presence/absence for environmental review only requires the cameras to be deployed for 10 days. If populations of DFS are small, the current requirements of one camera for each 5 acres of habitat and deployment length of 10 days may not be adequate to record squirrel presence.

The results of these photomonitoring studies show that the Prime Hook population of DFS is extant but the size and extent of the populations is impossible to ascertain from photomonitoring. Trapping and mark-recapture would be needed to accurately assess the health of the population. There are several other potential DFS habitats in the vicinity of the refuge that would warrant the deployment of photomonitoring arrays if landowners would agree to the surveys.



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